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## CERTIFICATE

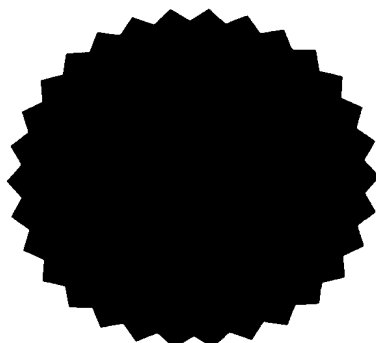
This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 12 March 1999 with an application for Letters Patent number 334619 made by WOOL RESEARCH ORGANISATION OF NEW ZEALAND INCORPORATED.

Dated 23 February 2000.

**PRIORITY  
DOCUMENT**  
SUBMITTED OR TRANSMITTED IN  
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Neville Harris  
Commissioner of Patents



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Patents Form No. 4

Our Ref: RL801936

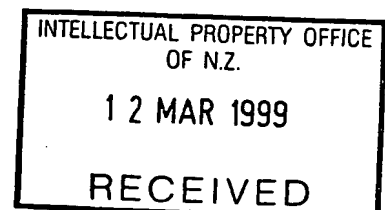
Patents Act 1953

PROVISIONAL SPECIFICATION

NON-SIMPLE HARMONIC MOTION LOOPER

We, **WOOL RESEARCH ORGANISATION OF NEW ZEALAND (INC.)**, an incorporated society under the laws of New Zealand, of Cnr Springs Road & Gerald Street, Lincoln, Canterbury New Zealand do hereby declare this invention to be described in the following statement:

PT0490798



## NON-SIMPLE HARMONIC MOTION LOOPER

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### FIELD OF THE INVENTION

The invention relates to the action of the loopers of tufting machines, the looper action being adapted to give improved pick up performance and greater control of the loopers by non-simple harmonic motion of the loopers.

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### BACKGROUND TO THE INVENTION

The action of a looper in a tufting machine is controlled by a main drive. The coupling between a looper bar supporting a plurality of loopers in a tufting machine and the main drive may be direct or through other mechanical systems to reduce inertia and vibration but, to the best of the applicants knowledge, the loopers follow a simple harmonic motion.

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The most common looper action follows an arc whereby the loopers are "rocked" out(or oscillated) to a pick-up point and back to a position to clear needles of the tufting machine. Patents for a linear motion looper action US Patent No. 5645001 and 4759199 (assignee Tuftco) have been found. With both arcuate and linear motion the timing of the looper action is critical for good tufting. Furthermore the way in which the looper picks the yarn off the needle, holds it while the needle withdraws and casts off the loop have significant effect on a carpet surface produced in a tufting machine.

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Looper timing and set-up are relatively frequently adjusted parameters with different carpet qualities requiring different settings for these parameters.

The means of adjustment of the looper action for timing and pick-up are generally very crude, in some cases involving releasing mounting clamps and knocking the looper assembly into another position with a hammer.

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An object of the invention is to overcome the identified disadvantages, provide an alternative choice and improve looper action and performance.

Further objects of the invention will become apparent from the following descriptions.

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#### SUMMARY OF THE INVENTION

According to a broadest aspect of the invention there is provided a tufting machine in which the looper action is a non- simple harmonic motion.

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The looper action, ease of set up and fine tuning can be greatly improved by decoupling the looper drive system from the main drive of the tufting machine. A non-simple-harmonic-motion(n-SHM) looper drive can be used to give significant advantages.

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Mechanical systems(e.g. cams) can be used to achieve n-SHM looper action with significant improvements in comparison to the conventional looper action. The greatest advantages for a decoupled looper drive system would be achieved through the use of a computer controlled drive system.

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### PREFERRED EXAMPLES

A comparison between conventional simple harmonic motion (SHM) looper action  
5 and the non-simple harmonic looper action of the present invention is shown in the  
accompanying drawings in which:

Figure 1 shows conventional simple harmonic motion looper and needle  
action.

10 Figure 2 shows an example of a non-simple harmonic motion for a looper  
with the (SHM) needle path shown as well.

In Figure 1 the needle oscillates between top dead centre (TDC) and bottom  
dead centre (BDC) with a SHM. The looper oscillates between fully  
extended and fully retracted with a SHM.

15 A non-simple-harmonic-motion looper action enables more precise control of the  
timing for the looper extension to pick-up the yarn from the needle at the  
optimum position on the needle. Furthermore, the looper can remain "extended"  
to hold the loop until later in a tufting cycle, i.e. until the backing has advanced on  
20 to trap the backstitch under the presser foot to reduce the tendency for yarn to be  
"robbed-back" as the next tuft is inserted.

In more sophisticated versions, the looper can "track" the tuft at the same speed  
as the backing advance to maintain the loop height, shape, etc.

A computer controlled looper drive system also enables the action to be electronically fine-tuned to a high level of precision. Different set ups can be achieved automatically for a different product as is currently done for other tufting parameters, such as yarn feed, pile height, primary backing feed, etc, as in US 4867080.

Patterning effects may also be possible through pile height control and variation by the modified action of the looper.

10 It is expected that a n-SHM looper action would also lead to reduced machine vibration, which in turn, could enable higher speed operation. Further advantages should also accrue through the use of shorter looper strokes and intermittent (compared with continuous) looper action.

15 Where in the foregoing description particular reference has been made to mechanical equipment it is envisaged that their mechanical equivalents can be substituted as if they were individually set forth.

Thus by this invention there is provided a tufting machine in which the motion of  
20 its loopers is non-simple harmonic motion.

Particular examples of the invention have been described and it is envisaged that improvements and modifications can take place without departing from the scope thereof.

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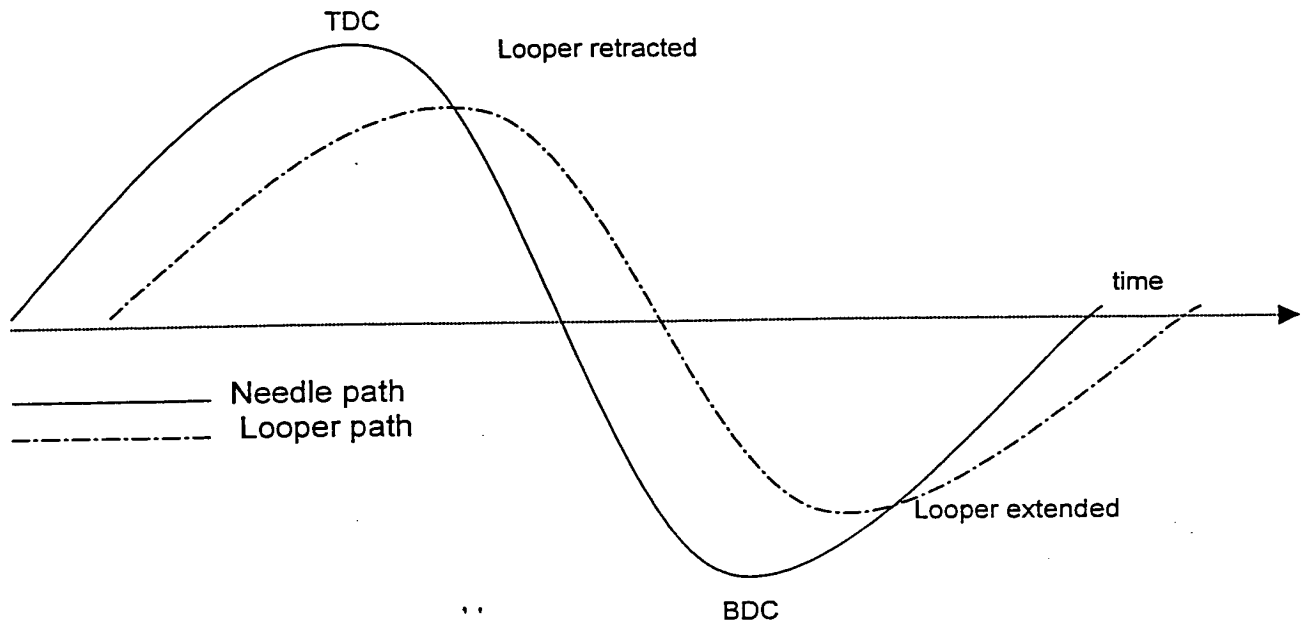
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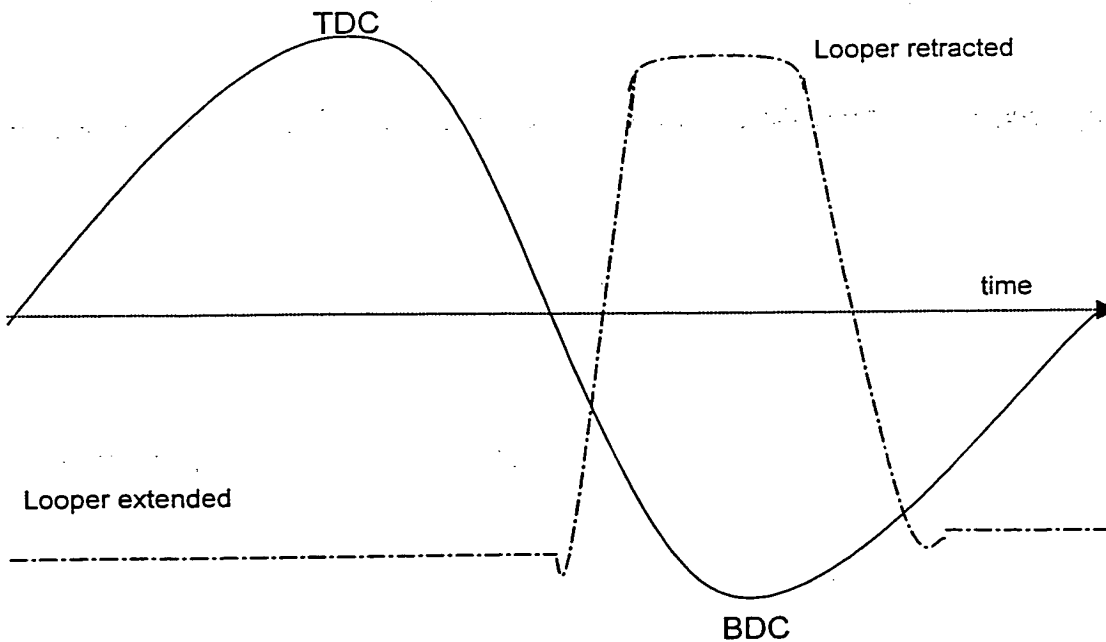


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**Fig. 1**  
Conventional Simple-Harmonic-Motion Needle and Loper Action



**Fig. 2**  
New Non-Simple-Harmonic-Motion Loper Action



Needle path  
Looper path

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